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METHODOLOGICAL ISSUES

Issues related to land-use change and forestry

Note by the secretariat

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I. INTRODUCTION

A. Mandate

1. At its third session, the Conference of the Parties (COP) by its decision 1/CP.3 requested the Chairman of the Subsidiary Body for Scientific and Technological Advice (SBSTA) and the Chairman of the Subsidiary Body for Implementation (SBI), taking into account the approved programme budget for the biennium 1998-1999 and the related programme of work of the secretariat, to give guidance to the secretariat on the preparatory work needed for consideration by the COP, at its fourth session, on matters related to the "Determination of modalities, rules and guidelines as to how, and which, additional human-induced activities related to changes in greenhouse gas emissions by sources and removals by sinks in the agricultural soils and the land-use change and forestry categories shall be added to, or subtracted from, the assigned amounts for Parties to the Protocol included in Annex I to the Convention, as provided for under Article 3, paragraph 4, of the Protocol" (FCCC/CP/1997/7/Add.1).

B. Scope of the note

2. This note provides preliminary information on land-use change and forestry (LUCF) and agricultural soil activities addressed in the Kyoto Protocol. To keep the note simple, terms used in several articles of the Protocol are treated, to the extent possible, only once. In particular the note:

(a) Identifies issues arising from the Protocol such as definitions;

(b) Provides options for clarifying the issues; and

(c) Identifies further work needed to resolve the issues.

Draft copies of this note were provided to participants attending the IPCC Expert Meeting on Harvested Wood Products, in Dakar, Senegal, 5-7 May 1998, for reference in their discussions on LUCF.

C. Possible action by the SBSTA

3. The SBSTA may wish to consider the list of questions related to LUCF and agricultural soils, bearing in mind that general policy issues related to Articles 6 and 12 of the Protocol are best considered under item 8 of the provisional agenda. It may wish to provide guidance to the secretariat on the preparatory work needed for future sessions. This could include the questions it wishes the secretariat to address and any process, such as the use of the roster of experts, for doing so. It may also wish to identify the questions on which advice should be sought from the IPCC and other international organizations and the possible timing and form of a response.

II. REVIEW OF THE PROTOCOL ARTICLES DEALING WITH LAND-USE CHANGE AND FORESTRY

A. Background

4. Forests are assemblages of ecosystems comprised of trees, other vegetation, litter and soils, each having its own temporal dynamics, carbon storage patterns, and carbon release rates to the atmosphere. Trees live and grow over long periods stretching from decades to hundreds of years. When trees die, the carbon sequestered over the years is transferred to the litter and soil, and is released to the atmosphere, or is incorporated into forest products. Some of these processes transfer carbon almost immediately, while others take several years. The temporal nature of carbon emissions and sequestration is particularly challenging in terms of the collection of data on, and the estimation of, carbon stocks and their changes over time as applied to the Protocol.

5. The Kyoto Protocol contains several articles that refer to, or raise issues regarding, LUCF. The following is a brief summary of these articles.

6. Article 2 of the Protocol calls on Annex I Parties to implement and/or further elaborate policies and measures, in accordance with their national circumstances, for the protection and enhancement of sinks and reservoirs of greenhouse gases not controlled by the Montreal Protocol. The Parties are advised to take into account their commitments under relevant international environmental agreements, including promotion of sustainable forest management practices, afforestation and reforestation. The article also addresses other sectors, such as energy and agriculture.

7. Article 3.3 and 3.4 of the Kyoto Protocol addresses LUCF activities that may be used to meet commitments of Annex I Parties to the Protocol and identifies a process for their elaboration. Article 3.3 provides a way to consider changes in net emissions from LUCF activities (limited to afforestation, reforestation and deforestation) measured in terms of verifiable changes in carbon stocks in each commitment period. The greenhouse gas emissions by sources and removals by sinks are to be reported in a transparent and verifiable manner, and reviewed in accordance with Articles 7 and 8.

8. Article 3.4 of the Protocol requires each Party included in Annex I to provide, for consideration by the Subsidiary Body for Scientific and Technological Advice, data to establish its level of carbon stocks in 1990, and to enable an estimate to be made of its changes in carbon stocks in subsequent years. It also provides a means whereby additional human-induced activities related to changes in greenhouse gas emissions by sources and removals by sinks in the agricultural soils and the land-use change and forestry categories shall be added to, or subtracted from, the assigned amounts for Parties included in Annex I. This would take into account uncertainties, transparency in reporting, and verifiability. The article specifies that the decision concerning inclusion of additional activities is to be based on the methodological work of the Intergovernmental Panel on Climate Change and the advice provided by the SBSTA.

Parties may choose to apply a decision on these additional human-induced activities to the first commitment period, provided that the activities have taken place since 1990.

9. The advice provided by the SBSTA in Article 3.4 must be in accordance with Article 5, which calls for establishing a national system for the estimation of emissions by sources and removals by sinks. Article 5 also specifies that methodologies used for these national systems shall be those accepted by the IPCC, and agreed upon at COP 3. Revisions to these methodologies may be adopted at the COP taking into account the work of the IPCC and advice provided by the SBSTA. Any revisions to methodologies or adjustments shall be used for purposes of ascertaining compliance with commitments under Article 3 in respect to any commitment period adopted subsequent to that revision.

10. Article 3.7 allows Parties included in Annex I (for whom land-use change and forestry constituted a net source of greenhouse gas emissions in 1990) to include in their 1990 emissions base year or period the aggregate anthropogenic carbon dioxide equivalent emissions by sources minus removals by sinks in 1990 from land-use change for the purposes of calculating their assigned amount.

11. Article 6 of the Protocol provides for the transfer or acquisition of emission reduction units resulting from projects between Annex I Parties. The article mentions both emissions by sources and enhancement of removals by sinks of greenhouse gases in any sector of the economy. It does not specify which LUCF activities might be pursued by the Parties for this purpose. It states that any project that provides a reduction in emissions by sources or an enhancement of removals by sinks must be additional to any that would otherwise occur.

12. Article 7 requires Annex I Parties to submit an annual inventory of greenhouse gas (GHG) emissions by sources and removals by sinks. It specifies that the guidelines for the preparation of the national communications will be adopted at the first Conference of the Parties serving as the meeting of the Parties (MOP) to the Protocol, and reviewed periodically thereafter.

13. Article 12 of the Protocol defines the clean development mechanism (CDM) as a means of assisting non-Annex I Parties to achieve sustainable development and to contribute to the ultimate objective of the Convention. It is also aimed at assisting Annex I Parties to the Convention to achieve compliance with their quantified emission limitation and reduction commitments under Article 3. Article 12 does not specify which project activities related to emission limitations and reductions are to be included or excluded. Emission reductions are to be certified on the basis that, among other things, they are additional to any that would occur in the absence of the certified project activity. The article does not refer to "removals by sinks".

14. The articles most directly related to methodological and reporting aspects, namely 3.3, 3.4, 3.7, 5 and 7, are discussed immediately below. Other related articles, namely 2, 6 and 12, are discussed later in the document.

B. Article 3.3, 3.4, 3.7, and Articles 5 and 7

1. Definitions

15. The following terms need clear definition: forests, afforestation, reforestation, deforestation, carbon stocks, and (direct) human-induced activities. The discussion that follows notes whether the term has been defined in the IPCC Guidelines, explores the use of alternative definitions, and, where possible, suggests optional definitions of the terms.

(a) Forests

16. *Question: How should forests be defined?*

17. There are several definitions of forests but the IPCC Guidelines do not provide any. One source identified five definitions[1]. Many operational definitions refer to forests as "land areas with a minimum of 10 per cent crown coverage of trees or bamboo". Some emphasize the existence of wild or natural conditions, others a minimum area size and the absence of agricultural practices. Still others define a forest as an area of tree-covered land typically consisting of hundreds or thousands (or more) of individual stands comprising trees of similar species composition, age-structure and management regime.[2,3,4] From a carbon accounting perspective, the term "forest" is often interpreted to also include "below ground vegetation", forest floor detritus (litter) and soil as part of the forest ecosystem. Clearly, the definition adopted has important implications for the Kyoto Protocol. For example, if literally interpreted, the conventional operational definition leaves out areas that have been clear-cut (that is, those that for many years will have less than 10 per cent crown cover) as part of a forest management system and components (such as litter and soils) that may contribute substantially to carbon reservoirs and changes in them.

(b) Afforestation, reforestation and deforestation

18. *Question: How should afforestation be defined? For the purposes of the first commitment period of the Kyoto Protocol, would it suffice to specify that afforested land pertains to areas which were not covered by forests in 1990? What date might apply to the subsequent commitment periods?*

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[1] Gyde Lund (1998). *Definitions of Deforestation, Afforestation and Reforestation.* A report prepared for the US Forest Service. Web site: http://home.att.net/~gklund/

[2] Glossary in M.J. Apps and D.T. Price (eds.) (1996). *Forest Ecosystems, Forest Management and the Global Carbon Cycle.* NATO ASI Series I (Global Environmental Change), vol. I 40, Springer-Verlag Academic publishers, Heidelberg.

[3] "State of the World's Forests", FAO (1997).

[4] "Temperate and Boreal Forest Resources Assessment 2000, Terms and Definitions", UN-ECE/FAO (1997).

19. The Kyoto Protocol permits consideration of "afforestation, reforestation, and deforestation" without providing definitions for these three words. The words "afforestation" and "reforestation" (but not "deforestation") are defined in the Glossary of the IPCC Methodology for National Greenhouse Gas Inventories.

20. The word "afforestation" does not appear to create a problem, and the intent of the Protocol seems consistent with conventional definitions of this word. The IPCC Guidelines define afforestation as the "planting of new forests on lands which historically have not contained forests". Accepting a link to the IPCC methodology, Parties could choose to use this definition. Given the language in Article 3.3, it appears that afforestation activities begun in 1990 and subsequent years could be counted (also see paragraph 51). The date to be used for subsequent periods could also refer to 1990 or another year, depending on the definition of the second and subsequent commitment periods.

(c) Reforestation

21. *Question: How should reforestation be defined? What time period is appropriate for other land-use prior to reforestation; for example, would 20 years be appropriate? Should this be different for the first and subsequent commitment periods?*

22. The IPCC Guidelines define reforestation as "planting of forests on lands which, historically, previously, contained forests, but which have been converted to some other use". Most other definitions, including the one used by the United Nations Food and Agriculture Organization (FAO), do not imply a previous conversion to other land-use. Annex I contains several published definitions of "reforestation" which suggest that many foresters would include the natural or enhanced regeneration of trees immediately following harvest in their definition.

23. Under the IPCC definition, some forest management systems, common in the boreal and temperate zones (where planting is done after clear-cutting), might not be included as reforestation, since land-use change is not involved. This would limit the land area available for offsets. Alternatively, if a definition of reforestation is adopted that allows for planting after harvesting in a forest management system, it would cover most managed forests, and the area that could potentially be claimed as a sink would increase substantially.

24. If the IPCC definition is to be used then there are two additional issues which would need to be resolved.

(a) *How should the term "planting" be defined?*

The use of the term "planting" implies that natural revegetation would be excluded. If both planting and natural revegetation are to be included then in place of "planting", the term "establishing" might be used to denote both phenomena.

(b) *How should the term "historical" be defined?*

The Protocol does not specify the length of time that should occur between deforestation and "establishment" in order to qualify as reforestation. Historical time periods vary by country, and may extend from 20 to 1,000 years or more. If the "historic" period is less than 20 years, countries would be able to convert natural forests to other land uses, begin a plantation scheme, and then declare these lands as "reforested". In this case "reforestation" would lead to net emissions rather than sinks.

25. Considering these two issues, the SBSTA may wish to consider whether reforestation could be defined as establishing forests on lands which have, historically, previously contained forests, but which have been converted to some other use. This other land-use must have prevailed for at least 20 (or some other number to be determined) years. The other land-use can be shorter if the land has been counted as "deforested" within a commitment period specified under the Protocol.

(d) Deforestation

26. *Question: How should deforestation be defined? What time period is appropriate for land to be defined as deforested? Should this be different for the first and subsequent commitment periods?*

27. The IPCC Guidelines do not provide a definition of deforestation. One source has identified nine definitions.[5] It is difficult to find a definition that encompasses the diversity of situations present in industrialized and developing countries. In order to construct a consistent definition, consideration must be given to what constitutes a forest and to the period during which land might be used for an alternative purpose. The definition of the word deforestation is also linked to that of reforestation. If the aforementioned definition of reforestation is adopted (paragraph 25), then deforestation could be defined as "the conversion of forest land to other land-use".

28. If the IPCC definition of reforestation is retained, then the following two alternative definitions of deforestation could be considered:

(a) "The direct human-induced change of land-use from forest to other land-use OR the depletion of forest crown cover to less than 10 per cent". This definition would cover activities leading to an actual land-use change and the unsustainable management of forests or clandestine logging leading to a substantial impoverishment (crown cover less than 10 per cent), but it does not accommodate degradation. Sustainable logging (including clear-cutting after harvesting) is to be excluded from consideration.

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[5] Lund, *op. cit.* Deforestation is to be distinguished from forest degradation. The latter refers to changes within the forest class, which negatively affect the stand or site and, in particular, lower the production capacity.

(b) "The direct human-induced change of land-use from forest to other land-use AND the depletion of forest crown cover to less than 10 per cent". In this case, while sustainable logging (for example, systems including clear-cutting and enhanced regeneration) would still be excluded from the definition, neither degradation nor unsustainable or clandestine logging would be reported as deforestation.

29. In either of the above two cases, a *time interval* during which lands remain without forest cover might need to be added to avoid claiming a "reforestation" project on previously deforested land within the first commitment period.

(e) Direct human-induced activities

30. *Question: Should policies and programmes be counted as direct human-induced activities or only the physical activities on the land? Should the prevention or suppression of natural phenomena that destroy forests be included in this definition? Is it necessary to distinguish between intent and consequence of human-induced activity?*

31. Article 3.3 includes the term "direct" before human-induced activities. The term direct could refer to policies or programmes; the physical activities of afforestation, reforestation or reducing deforestation; or both of these. For example, governments could change tax policy to accelerate the rate of conversion of agricultural land to forests, or initiate large-scale programmes to increase the planted area. However, in such cases, there may be a time lag between adoption of a policy and the induced physical activity. Alternatively, governments could choose to better protect forests through improved monitoring and physical barriers to encroachment in order to reduce deforestation. Interventions to prevent or suppress forest fires could also constitute direct activities to reduce deforestation. In each case, the change in carbon stocks would be the measure of whether the human-induced activities had an impact and not merely the announcement of policies, programmes and direct intervention activities.

32. Yet another type of challenge is posed in defining "direct" in instances where the boundary between human- and naturally-induced phenomena is unclear. Human-induced fires may be used to clear land for plantations or other agricultural activities. If these fires, assisted by natural elements, were to spread to other neighbouring areas, the fires could destroy a much larger area than originally intended. The area covered by the original intent and the eventual consequence could thus be very different.

(f) Carbon stocks

33. *Question: How many carbon pools should be included in the definition of carbon stocks, and under what circumstances?*

34. Article 3.3 states that net emissions and sinks from land-use change and forestry activities will be "measured as verifiable changes in stocks in each commitment period"; Article 3.4 asserts

that each Annex I country shall provide data to "establish its level of carbon stocks in 1990 and to enable an estimate to be made of its changes in carbon stocks in subsequent years".

35. The term carbon stocks is not defined in the IPCC Guidelines. An important issue is to determine which carbon pools are to be included in the carbon stock. Carbon influenced by human-induced LUCF activity may be considered to be stored in five pools: above- and below-ground biomass, soils, wood products and landfills. The fossil-fuel carbon pool, while influenced by LUCF activities, is generally not considered as a terrestrial carbon pool.

36. Not all pools are easily measured and quantified, which may create a tendency to focus on those that can be assessed and to ignore the rest. While it is useful to quantify all pools to the extent possible, it is critical, when estimating pools whose carbon stock is increasing, to ensure that the remaining pools are not depleted due to the activities being pursued.[6] In tropical forests, for example, soil carbon stocks may not increase or increase very little and a Party might choose to avoid the expense of verifying changes in these pools by not claiming credit for them. In such cases, however, it may be necessary for the Party to demonstrate that these other pools are not degraded by the reported activity. Similarly, some activities, such as silviculture, may increase timber biomass stocks at the expense of carbon in litter, soil or other vegetation, resulting in little or no real increase in withdrawal from the atmosphere. To avoid inaccurate accounting, it may be important for Parties to report both the increase and depletion of carbon stocks, or at a minimum, to demonstrate that carbon is not lost from pools for which no improvement is being claimed.

37. Deforestation can yield forest products which may store carbon for decades. The current IPCC approach does not account for forest products.

2. Alternative approaches to account for LUCF activities

38. *Question: How should emission reductions and removals by sinks from the LUCF activities, as stipulated in Article 3.3, be interpreted and estimated?*

39. Emission reductions and removals by sinks from the LUCF activities could be estimated on the basis of Article 3.3 in two ways. A third approach is also presented.

40. The first clause in Article 3.3 states: "The net changes in greenhouse gas emissions by sources and removals by sinks resulting from direct human-induced land-use change and forestry activities, limited to afforestation, reforestation and deforestation since 1990, ... shall be used to meet the commitments under this Article ...". This phrase is limited by an additional clause, which specifies that these net changes in emissions will be "measured as verifiable *changes in*

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[6] J. Sathaye et al. (eds.) (1997). "Monitoring and verification of greenhouse gases" (Summary Statement. International workshop on sustainable forestry management). *Mitigation and Adaptation Strategies for Global Change*, vol. 2 (2-3), pp. 101-115.

carbon stocks in each commitment period". This italicized clause leads to the first interpretation for accounting changes in carbon stocks:

41. Interpretation 1 (method 1): The net change in emissions, as measured by changes in carbon stock from afforestation, reforestation and deforestation activities, that may be used to offset emissions in the commitment period = (carbon stock on 31 December 2012) - (carbon stock on 1 January 2008).

42. A second interpretation of Article 3.3 comes about if the net changes in greenhouse gas emissions by sources and removals by sinks from afforestation, reforestation and deforestation activities are to be measured with respect to 1990. The phrase "*... since 1990,..*" coupled with change in changes in carbon stocks suggests the following interpretation:

43. Interpretation 2 (method 2): The change in changes in carbon stock (CCCS) to offset emissions from other sectors during the commitment period = (average rate of change in carbon stock in 2008-2012) - (rate of change in stock during 1990).[7]

44. These interpretations and associated methods would provide estimates of changes in carbon stock during the commitment period. The second interpretation gives credit to a Party only if it has improved its rate of stock accumulation during the commitment period compared to that during the base year 1990. If the rate has not changed, the Party will not receive a credit for net greenhouse gas removals during the commitment period. For this reason, if the 1990 rate of carbon stock change is anything other than zero, the two methods give different answers.

45. The accounting approach of the second interpretation parallels the approach stated in Article 3.7 for the estimation of the assigned amount for each Party. Article 3.7 states that the assigned amount shall be equal to the percentage inscribed in annex B of its aggregate CO_2 equivalent emissions in the base year. Interpretation 2 compares the emissions rate during the commitment period with that during the base year (1990). While the first interpretation would give credit to any net GHG removals during the commitment period, the second method would do so only if a Party had shown an improvement compared to 1990.

46. A third approach (method) might be to measure the cumulative change in carbon stock between 1990 and the average value during the commitment period. This may be stated as:

47. Interpretation 3 (method 3): The cumulative change in carbon stock = (average stock in 2008-2012 period) - (carbon stock in 1990).

48. This approach provides a cumulative measure of a project's contribution to reducing the atmospheric accumulation of greenhouse gases since 1990. The cumulative value cannot be compared with the assigned amount as stated in Article 3.7, but may be compared with the cumulative emissions from the non-LUCF sectors between 1990 and the commitment period. It

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[7] The change in carbon stock during the commitment period = 5 x CCCS

would be analogous to crediting the cumulative emission reduction since 1990 below a baseline from an automobile fleet against the average emissions in the commitment period.

49. Each approach provides a different estimate of the changes in carbon stock. The amount would depend on the magnitude of the emissions or removals from the LUCF sector resulting from the afforestation, reforestation and deforestation activities of each Party. It would also depend on the definitions that Parties may wish to adopt. The secretariat does not have information from Parties on all LUCF emissions from sources and removals by sinks, and therefore can not provide numerical examples of the implications of each of these approaches to meet commitments. However, in general, it is likely method 1 will generate higher offsets than method 2 for countries that are net LUCF sinks in 1990. Also, method 2 will probably generate higher offsets than method 1 for countries that are net LUCF sources in 1990.

3. Other issues

50. *Question: Do the words "since 1990" in Article 3.3 mean beginning in 1991, or including 1990?*

51. The term "since 1990" in the protocol is interpreted to mean that the year 1990 is to be considered as the base year for all estimations. It is also possible to interpret the word to mean a period beginning in 1991, in which case the activities will have to be those that are initiated in 1991 and not in 1990. A clarification of the term "since 1990" is needed.

52. *Question: How should the "additional activities" referred to in Article 3.4 be determined? What framework should be used to guide the inclusion of additional activities? Are the accounting approaches discussed for Article 3.3 valid for additional activities?*

53. The first sentence of Article 3.4 stipulates that each Annex I Party shall provide, for consideration by the SBSTA, data to establish its level of carbon stocks in 1990 and to enable an estimate to be made of its changes of carbon stocks in subsequent years. This sentence seems to imply that interpretation 2 above should be used for calculating the changes in carbon stocks. Interpretation 2 would require, at a minimum, the establishment of data on stocks affected by activities to afforest, reforest or reduce deforestation, which are a subset of total forestry activities. Parties would need to consider whether such data would need to be more detailed than that provided for under current IPCC Guidelines.

54. Article 3.4 of the Protocol stipulates that the COP will decide modalities, rules, and guidelines, as to how and which additional human-induced activities in the agricultural soils and LUCF categories are to be added to afforestation, reforestation and deforestation activities. A preliminary list of activities that might be considered for addition to the Protocol is provided in annex II below for consideration. Alternatively, a full accounting approach for all activities and carbon pools may need to be considered. Article 3.4 also notes that these additional activities could be used to meet a Party's assigned amount taking into account uncertainties, transparency

in reporting, verifiability, the methodological work of the IPCC, and the advice provided by the SBSTA. Uncertainty, transparency and verifiability are terms that are not defined in the article.

55. *Question: What is meant by the term "uncertainty"?*

56. Uncertainties associated with Article 3.4 may need to be considered in the broader context of other articles, for example Articles 5, 7 and 18. Uncertainties vary widely among different greenhouse gases, source categories of each gas, the type and length of an activity and projects. Uncertainty could refer to the *technical* reliability of emission estimates, and to *institutional soundness* of organizations conducting afforestation, reforestation, deforestation and other activities. Examples of the first type of uncertainty are:

(a) Differing interpretations of source and sink categories or other definitions, assumptions, or units;

(b) Use of simplified data formats and average values (especially emission sequestration factors);

(c) Uncertainties introduced by changing national models for estimating activities, or random errors in reporting; and

(d) Inherent uncertainty in the scientific understanding of the basic processes leading to emissions and removals.

57. Institutions affect uncertainties through project development, construction and operational procedures. Institutional uncertainty is affected, among other things, by financing, management, legislation, and rules and regulations that govern the conduct of projects. Parties may need to consider institutional uncertainties in the context of Articles 6 and 12.

58. *Question: What is meant by transparency in reporting?*

59. Heretofore, in the context of the Convention, transparency in reporting has been generally taken to mean that the assumptions and methods of analysis should be easily understood and/or replicable by international experts using information provided in the national communications. Parties may need to determine whether the reporting of data, assumptions and methods used in the LUCF activities would need to be different from those in the current UNFCCC guidelines. In this context, how should "work sheets" or "equivalent information", required under current guidelines, be defined.

60. *Question: What is meant by verification of LUCF and agricultural soil emissions by sources, and sequestration by sinks?*

61. Verification is a generic issue that may need to be discussed in a wider context. Parties may need to determine whether LUCF and agricultural soil activities would need to be verified in

a similar or different manner than other emission sources. In the LUCF area, verification could refer to establishing whether the activities and the associated changes in carbon stocks actually occurred.[8] The following are few examples of verification approaches:

(a) Review of the data, documentation, procedures and methodologies;

(b) Comparative analyses of procedures and methods; and

(c) Repeat sampling and measurements.

62. To some extent, verifiability of LUCF and agricultural soils may have to be flexible and based on the pools that are quantifiable. However, there may be no incentive to verify and report negative stock-changes, such as in deforestation, although the word "shall" in Article 3.3 implies that stock-changes have to be reported, even if they are negative. Thus, if carbon gains are eligible, reporting and verification of such carbon losses might have to be obligatory.

63. *Question: Does the Article allow inclusion of both "direct and indirect" human-induced activities?*

64. Unlike Article 3.3, no mention is made of the term "direct" with respect to human-induced activities in Article 3.4. This may raise a question about whether indirect results of human-induced activities, such as CO_2 and nitrogen fertilization by the atmosphere, should be included.

65. *Question: What should guide the inclusion of additional activities?*

66. The last sentence of Article 3.4 appears to leave the reporting of the carbon sources and sinks from "additional human-induced" activities during the first commitment period to Parties. Countries with increased carbon stocks in the respective categories would probably tend to report this, whereas countries with a net source of carbon might choose not to report. Also, a country could choose to report only some of the activities, such as those that help it to meet its commitments, and not others.

67. The potential impact from "additional" activities could be large. Parties may need to give consideration to the type of information needed by the COP to make decisions. For example, would the COP need an estimate of potential national and global emission reductions or sequestration amounts?

68. Forests store carbon in a cyclical pattern in which carbon removed from the atmosphere over a period of years is later released through natural and human-induced phenomena. The

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[8] E. Vine and J. Sathaye (1997). "The Monitoring, Evaluation, Reporting and Verification of Climate Change. Mitigation Projects: Discussion of Issues and Methodologies and Review of Existing Protocols and Guidelines". LBNL Report No. 40316.

practices of afforestation and reforestation will increase forest carbon stock in the short run, but eventually these could be depleted as trees die as part of their natural cycle. It is therefore important to consider both the carbon that will be sequestered (credits) by the afforestation, reforestation and reduced deforestation and activities and that which could be released (debits) at a later stage. In Article 3.4, for the additional activities, the entire cycle, that is, both credits and debits, may therefore need to be considered among the five carbon pools mentioned in paragraph 36.

69. Question: *"Is the term "land-use change and forestry" to be used consistently in Article 3.7?"*

70. Article 3.7 stipulates that "for Parties included in Annex I for whom land-use change and forestry constituted a net source of greenhouse gas emissions in 1990 shall include in their 1990 emissions base year or period the aggregate anthropogenic carbon dioxide equivalent emissions by sources minus removals by sinks in 1990 from land-use change for the purposes of calculating their assigned amount. Given the criteria stipulated in the first phrase, is it reasonable to assume that forest emissions would also be included in the 1990 base year amount?

71. *Question: To what extent can the Revised 1996 IPCC Guidelines for estimating GHG removals and sinks for LUCF (or for estimating changes in carbon stocks) serve as a basis for complying with Article 5 of the Kyoto Protocol? If needed, how should the IPCC Guidelines be modified in a manner consistent with their application by the UNFCCC?*

72. The current 1996 IPCC Revised Guidelines for assessing LUCF inventories propose a methodology that is based on two linked themes: the flux of CO_2 to, or from, the atmosphere is assumed to be equal to changes in carbon stocks in existing biomass and soils; and, the changes in carbon stocks can be estimated by determining the rate of change in land-use and the activity used to bring about the change. Simple assumptions are then applied about their impact on carbon stocks and the biological response to a given land-use. The 1996 Guidelines assess carbon stock changes, but use information about carbon flux (such as forest growth and harvest) to do so. In applying the IPCC Revised Guidelines, different assumptions could cause a forest to be classified as either a source or a sink.[9]

73. The 1996 Revised Guidelines provide information about how to account for some of the carbon pools, such as aboveground biomass and soil carbon. Few countries have reported information about these pools in their national communications to date. The other carbon pools, in belowground biomass, wood products, and landfill, are not accounted for in the Guidelines.

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[9] J. Greenough, M. Apps and W. Kurz (1997). "Influence of methodology and assumptions on reported national carbon flux inventories: An illustration from the Canadian forest sector", *Mitigation and Adaptation Strategies for Global Change*, vol. 2 (2-3), pp. 267-283.

C. Articles 2, 6 and 12

74. *Question: How should the term "sustainable forest management practices" as used in Article 2, be defined? What link, if any, should be made to the consideration of these practices under other articles, for example Article 3.4?*

75. Article 2 calls on Annex I Parties to "elaborate policies and measures to protect and enhance sinks ... and to promote sustainable forest management practices, afforestation and reforestation". It is the only article that refers to "sustainable forest management practices."

76. *Question: Should Article 6 cover the same activities stipulated in Article 3.3 and 3.4?*

77. Article 6 of the Protocol states that an Annex I Party may transfer to, or acquire from, any other such Party emission reduction units. It does not specify that projects in another country need to include the same LUCF activities provided for under Article 3.3. A paradox could arise if this were not the case. Without this understanding, country A could pursue a project (other than afforestation, reforestation, or deforestation) within country B and country B could pursue the same kind of project within country A, and both might receive more credits than if they pursued the same projects at home.[10]

78. *Question: Should Article 12 cover the same activities stipulated in Article 3.3 and 3.4?*

79. Article 12 of the Protocol addresses a clean development mechanism (CDM). Parties may wish to refer to the discussion of this issue in document FCCC/SB/1998/2. The article mentions certified emission reductions accruing from projects, but it does not refer to sequestration by sinks, as is the case in Article 6. A point to be considered on this matter is that curbing deforestation is a mean of reducing emissions.[11]

80. *Question: Should the type of data required for projects under Article 6 be different from, or consistent with, the type of data received for national GHG inventories?*

81. Currently, data provided with national inventories is quite general. Detailed information on the IPCC categories at either the national or sub-national level is usually not submitted in worksheet format to the secretariat. Article 6, which is based on projects, suggests a level of detail not so far provided by Parties. It may be necessary to consider whether a consistent format is desirable.

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[10] Schlamadinger and Marland, "Some technical issues regarding land-use change and forestry in the Kyoto Protocol, Proceedings of the IEA Bionergy Task XV Workshop 'Effects of the Kyoto Protocol on bioenergy and forestry projects for mitigation of net C emissions' " (1998, in press).

[11] Depending on the answer to this question, the following questions, which refer to Article 6, could also be applied to Article 12.

82. *Question: How can the maintenance of carbon pools be ensured once a project ends?*

83. Article 6 does not specify the fate of carbon pools after a project ends. The continued maintenance of carbon pools is important, as the stored carbon would otherwise be released to the atmosphere, thereby potentially affecting the basis of any emission reduction units. This issue may need to be considered in the context of modalities and procedures for these articles.

III. SHORT- AND LONG-TERM ISSUES

84. Many of the LUCF and agricultural soil issues related to the Protocol have been noted above. This section synthesizes them into short- and long-term issues.

A. Short-term issues

85. The early resolution of several aforementioned issues would aid in implementing the provisions of the Protocol. Most of the short-term issues are policy relevant and are concerned with (i) definitions of words and phrases in various articles of the Protocol, and (ii) clarification of phrases where the language lends itself to multiple interpretations that could yield different results in the estimation of emission reductions or sequestration by sinks. Examples of possible short-term issues that need resolution include:

(a) Definitions: There are several key words or phrases in Article 3.3 which are not defined in the Protocol, and have multiple definitions in the literature. The choice of definition could have significant policy implications. More work is needed to examine the alternative definitions and their implications for the LUCF situations that Parties might experience in the future. While the need for clear definitions is urgent in order to implement Article 3.3, this needs to be done in a manner consistent with all the articles in the Protocol;

(b) Reporting of information related to Articles 3.3 and 7: How should information related to Articles 3.3 and 7 be reported? Can the Revised 1996 IPCC Guidelines be used? What data and "equivalent information" should be provided, and in what format?

(c) Method of accounting for changes in carbon stocks: There appear to be alternative ways of interpreting the wording of Article 3.3, as discussed in paragraphs 38 to 40 above. The alternative methods can lead to different results for LUCF offsets for the same country. An early resolution of the method to be used by Parties to estimate their changes in carbon stock would help them to proceed with more confidence in pursuing appropriate afforestation, reforestation, and deforestation options. A related issue is the interpretation of the year indicated by the words "since 1990" in Article 3.3. It is useful to clarify whether this phrase refers to a period beginning in 1990, or to one beginning in 1991;

(d) Differences between Articles 3, 6 and 12 concerning the types of LUCF activities that may be included: Parties may wish to consider the differences in the treatment of LUCF

activities between Articles 3, 6 and 12 in the context of discussions under item 8 of the provisional agenda, bearing in mind that such differences could lead to paradoxical solutions, as noted in paragraph 77 above.

B. Long-term issues

86. Examples of issues that may need resolution over the long-term are primarily those arising from Article 3.4 and are generally more technical. The resolution of these issues could take a considerable amount of time.

(a) Inclusion of additional LUCF activities: Article 3.4 of the Protocol stipulates that the COP/meeting of the Parties (COP/MOP) will decide on modalities, rules and guidelines as to how, and which, additional human-induced activities in LUCF will be added to, or subtracted from, afforestation, reforestation and deforestation. Which activities should be added? What decision framework should be established, and what type of information would the COP need to guide a decision?

(b) Definitions: Article 3.4 also stipulates that the addition of activities should take into account uncertainties, transparency in reporting, and verifiability. How should this be done?

(c) Method of accounting for changes in carbon stocks: In paragraphs 38-49 above, alternative methods for the accounting of LUCF carbon offset based on Article 3.3 were discussed. Should these methods also be used to account for the additional activities and for projects under Article 6? Should the activities that are added, and the accounting approach that is adopted, be such as to ensure that both credits and debits are counted?

(d) Adequacy of IPCC Guidelines related to Article 3.4: The Revised 1996 IPCC Guidelines assess changes in carbon stocks, but use information about carbon flux (such as those from forest growth and harvest) to do so. They provide guidance on only two carbon pools, aboveground biomass and soil carbon. Could other carbon pools discussed in paragraph 35 be included without substantially affecting the application of the guidelines by the UNFCCC and, if so, should they be, or should a "full accounting" approach be considered? What are the practical implications (for example, the costs of collecting and reporting data)? Should future revisions to IPCC Guidelines be supported by stand and land-use dynamics models or common sampling methods to facilitate transparency and verifiability?

Annex I

ALTERNATIVE DEFINITIONS FOR AFFORESTATION, REFORESTATION AND DEFORESTATION

1. "State of the World's Forests", FAO, 1997, pp. 173-174

Afforestation/reafforestation: The establishment of a tree crop on an area from which it has always, or very long, been absent. Where such establishment fails and is repeated, the latter may properly be termed reafforestation.

Reforestation: Establishment of a tree crop on forest land.

Deforestation (developed countries): Change of forest with depletion of tree crown cover to less than 20 per cent.

Deforestation (developing countries): Change of forest with depletion of tree crown cover to less than 10 per cent. (Changes within the forest class, for example, from closed to open forest, which negatively affect the stand or site and, in particular, lower the production capacity, are termed forest degradation and are considered apart from deforestation.)

Forests (developed countries): Land with tree crown cover (stand density) of more than about 20 per cent of the area. Continuous forest with trees usually growing to more than about 7 m in height and able to produce wood. This includes both closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground, and open forest formations with a continuous grass layer in which tree synusia cover at least 10 per cent of the ground.

Forests (developing countries): Ecosystem with a minimum of 10 per cent crown cover of trees and/or bamboos, generally associated with wild flora, fauna and natural soil conditions, and not subject to agricultural practices.

2. IPCC. Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Reporting Instructions (vol. I), Glossary, pp. 1-18:

Afforestation: Planting of new forests on lands which, historically, have not contained forests. These newly-created forests are included in the category, "Changes in Forest and Other Woody Biomass Stocks", and in the LUCF module in the emission inventory calculations.

Reforestation: Planting of forests on lands which have, historically, previously contained forests but which have been converted to some other use. Replanted forests are included

in the category, "Changes in Forest and Other Woody Biomass Stocks", in the LUCF module of the emissions inventory calculations.

3. S. Brown, A.E. Lugo and J. Chapman (1986), "Biomass of tropical tree plantations and its implications for the global carbon budget", *Canadian Journal of Forest Research*, vol. 16, pp. 390-394[1]

Plantations are forest stands that have been established artificially to produce a forest product "crop". They are either on lands that previously have not supported forests for more than 50 years (afforestation), or on lands that have supported forests within the last 50 years and where the original crop has been replaced with a different one (reforestation).

4. Temperate and Boreal Forest Resources Assessment 2000, Terms and Definitions, UN-ECE/FAO, 1997, pp. 3

Forest: Land with tree crown cover (or equivalent stocking level) of more than 10 per cent and area of more than 0.5 ha. The trees should be able to reach a minimum height of 5 m at maturity in situ. May consist either of closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground; or of open forest formations with a continuous vegetation cover in which tree crown cover exceeds 10 per cent. Young natural stands and all plantations established for forestry purposes which have yet to reach a crown density of 10 per cent or tree height of 5 m are included under forest, as are areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention or natural causes but which are expected to revert to forest.

Includes: Forest nurseries and seed orchards that constitute an integral part of the forest; forest roads, cleared tracts, firebreaks and other small open areas within the forest; forest in national parks, nature reserves and other protected areas such as those of special environmental, scientific, historical, cultural or spiritual interest; windbreaks and shelterbelts of trees with an area of more than 0.5 ha and a width of more than 20 m. Rubberwood plantations and cork oak stands are included.

Excludes: Land predominantly used for agricultural practices.

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[1] This definition also appears in the Reference Manual for the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, chapter 5.14.

Annex II

PRELIMINARY LIST

ADDITIONAL HUMAN-INDUCED ACTIVITIES THAT MIGHT BE CONSIDERED UNDER ARTICLE 3.4

1. Activities to avoid carbon emissions (for example, reduce forest fires and insect infestation)

2. Activities to build soil carbon

3. Agrarian and pastoral practices

4. Conservation tillage

5. Forest management practices

6. Forest conservation

7. Harvesting

8. Increased wood product lifetimes

9. Low- or reduced-impact logging

10. Land-clearing for agriculture

11. Revegetation of degraded lands

12. Sequestration in wood products

13. Soil conservation

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